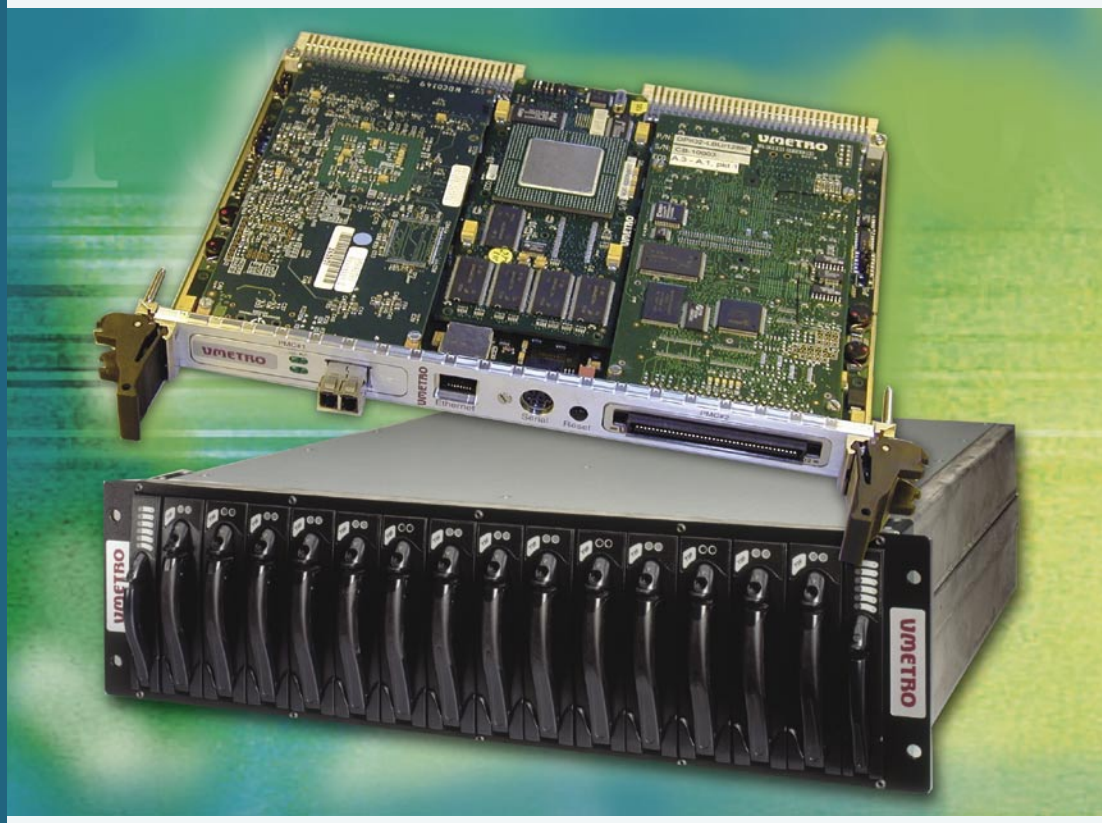
MDR-320/420

Real-Time Data Recorder



VMETRO

MDR-320/420

Real-Time Data Recorder

MDR Data Recorder & Playback Subsystem

- Ready programmed recorder for Industry standard interfaces (FPDP, FPDP II and Serial FPDP)
- Long duration recording to low-cost Fibre Channel JBODs
- Integrates easily into market specific applications
- Workstation host software support
- Models from 80 to 160 MBytes/sec

Proven Recording Engine:

- Optimized disk recording for maximum sustained bandwidth
- Easy connection to Storage Area Network (SAN)
- Group any set of disk drives on SAN
- RAID-0 disk group striping for sustained speed
- Optimized file system ensures real-time performance
- JBOD and RAID support
- Utilizes standard Fibre Channel SAN technology

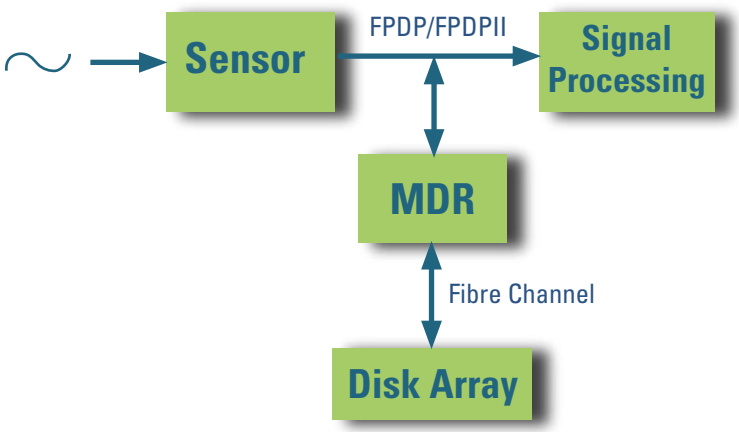
MDR Applications

- Radar and Sonar signal capture and playback
- Intelligence recording systems (SIGINT, COMINT, ELINT)
- Semiconductor quality inspections systems
- Seismic data acquisition
- Physics research
- Studio grade video recording, playback, archiving and editing

Long Duration Real-Time Recording

MDR is a family of ready-to-run VMEbus-based subsystems that offer up to Terabytes of real-time permanent recording or playback of high-speed digital data. Continuous real-time recording can be performed for minutes or hours, limited only by the capacity of the disk storage system. The MDR is typically used to record raw sensor data directly from the data path between A/D converters and DSP processors in systems such as radars, sonars etc. The product is also capable of doing fixed-rate playback of recorded or pre-loaded data, to feed data into a sensor data path for sensor emulation, system testing or verification purposes. MDR interfaces to the industry standard parallel FPDP, FPDP II or Serial FPDP for compatibility with 3rd-party A/D converters (ADCs) and DSPs. The parallel version can, in addition to the standard FPDP TTL signaling, be delivered with LVDS, RS-422/485 or PECL signaling.

MDR application example/principle



Features	Benefits
High-Speed real-time recording for minutes or hours	Record raw sensor data directly from ADCs for radar algorithm development, mission analysis etc.
FPDP, FPDP II or Serial FPDP interface	Compatibility with 3rd-party ADCs and DSPs
Fibre Channel disk interface	High speed, very scalable, convenient cabling. Redundant Array of Independent Disks. Redundancy offers protection against disk failure
JBOD disk arrays	Very cost effective, high capacity, scalable
RAID disk arrays	Redundancy offers protection against disk failure
Controlled with User I/F or C++ API	Use workstation or an embedded VxWorks VME host
Host access via Ethernet	Ready to run, or control from user application
Direct Fibre Channel host access to disks	Very fast readback of recorded data by host
Playback at real-time speed	Sensor emulation, system testing or verification

Industry Standard COTS modules

The MDR consists of a pre-programmed, self-contained VMEbus module and a separate storage system based on RAID or JBOD Fibre Channel disk arrays. All main components of an MDR system are based on industry standards (VME, PMC/PCI, Fibre Channel) and Commercial Off-The-Shelf (COTS) modules, such as the VMETRO MIDAS (Modular Intelligent Data Acquisition System) I/O board and selected PMC modules. The MDR board is intended to be integrated into a customer's VME chassis, typically together with 3rd-party ADC and DSP boards.

Host support – Ready-to-run Application or C++ API

The MDR is typically controlled from a host computer with a pre-programmed application (MDR Shell), or through a C++ API integrated with the customer application. Both of which are provided in the MDR package. The host communicates with the MDR using standard TCP/IP over Ethernet. The host can be a PC or workstation or an embedded VMEbus Single Board Computer (WindRiver VxWorks). To speed up access to recorded data by the host (or preload for playback purposes), a dedicated Fibre Channel link can be used directly between the host and the disk storage system.

Commercial or Ruggedized Versions

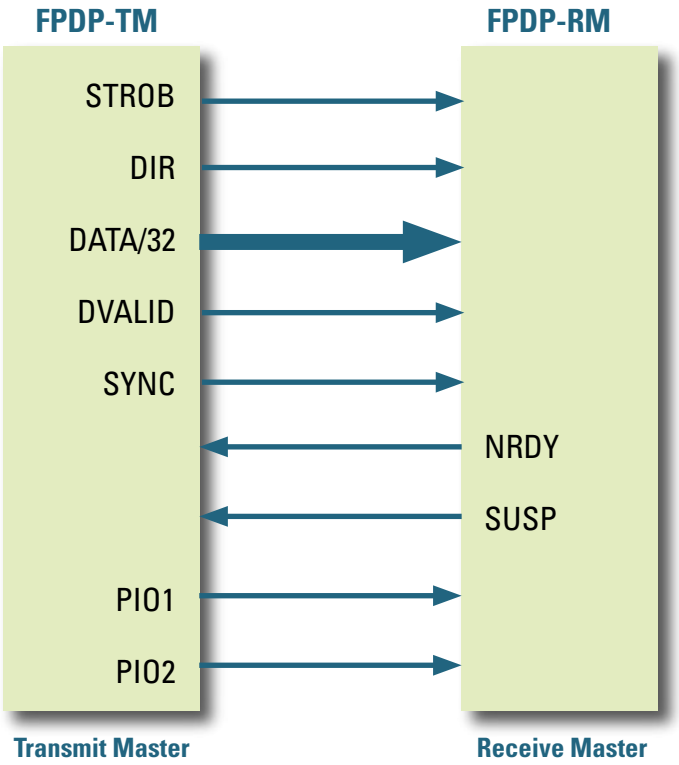
MDR is available with standard commercial environmental specifications, with an operating temperature range of 0-50°C for the MDR board and 0-25°C for the disk storage system. For ruggedized or extended temperature versions, please contact factory.

Digital Data Interfaces

FPDP - The Industry Standard

An MDR system interfaces to its data source with a digital I/O interface based on the popular FPDP (Front Panel Data Port) specification (ANSI/VITA 17). The FPDP interface is a 32-bit ribbon-cable synchronous parallel interface used by a variety of 3rd-party vendors for products such as ADC, DAC and DSP boards. Further information about the FPDP standard can be found at:

http://www.fpdp.com



STROB	Clock
DIR	Asserted by TM 16 clocks before DVALID
DATA/32	Up to 32-bit data bus
DVALID	Data bus has valid data
SYNC	Used to delimit or frame data SYNC with DVALID SYNC without DVALID
NRDY	Indicates RM not ready
SUSP	Flow control, indicates pending buffer overflow sender must stop within 16 clocks
PIO1,2	User defined - Can go either direction.

FPDP signals overview

Proprietary parallel ports

FPDP is normally limited to 1m (3.3') cable lengths. For applications that require longer cables, MDR also supports proprietary ports such as RS422/485 Differential TTL (up to 10m, max. 10 MHz sample rate) and LVDS (up to 10m, max. 50 MHz sample rate). There is also a PECL option, supporting sample rates up to 75MHz (max. 1m cable).

FPDP II – The Fully Compatible Enhancement of FPDP

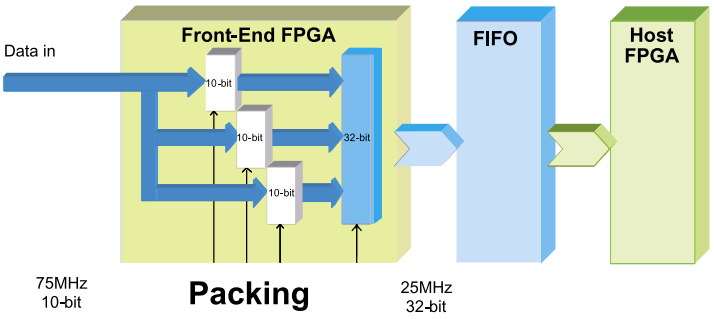
The continuing demand for higher speed data acquisition, processing and storage systems required an increase in throughput of FPDP. Consequently, a second generation FPDP, called FPDP II was proposed.

The original FPDP and the new FPDP II both define 32-bit synchronous input/output parallel interfaces. FPDP is specified to operate at clock rates of up to 40MHz, while FPDP II is specified to operate up to 50 MHz with clocking on both edges.
The double-edged clock in FPDP II doubles the bandwidth with no "real" increase in cable bandwidth. FPDP II builds on top of the strengths of FPDP and more than doubles the FPDP Burst data-rate from 160 to 400 MBytes/sec. FPDP II is backwards compatible with FPDP, hence reducing the necessary engineering effort for upgrading an application, whilst keeping existing systems compatible with new solutions.

DPIO2 advanced FPDP / FPDP II parallel I/O PMC module

Parallel data packing for narrow data paths

The hardware and software architecture of MDR is designed around a 32-bit data path. However, to facilitate data I/O width less than 32-bit without losing bandwidth, various data packing and unpacking options are available in the data interface. This is a very useful feature when connecting to ADC and DAC boards, which often have sample widths of only 8 to 16 bits. For example, if a 10-bit ADC is used, the MDR can pack three 10-bit samples in a 32-bit word before it gets recorded, wasting only 2 bits rather than 22 if no packing were used. The packing options provided are 2x16-bit, 3x10-bit words packed in or unpacked from a 32-bit word.

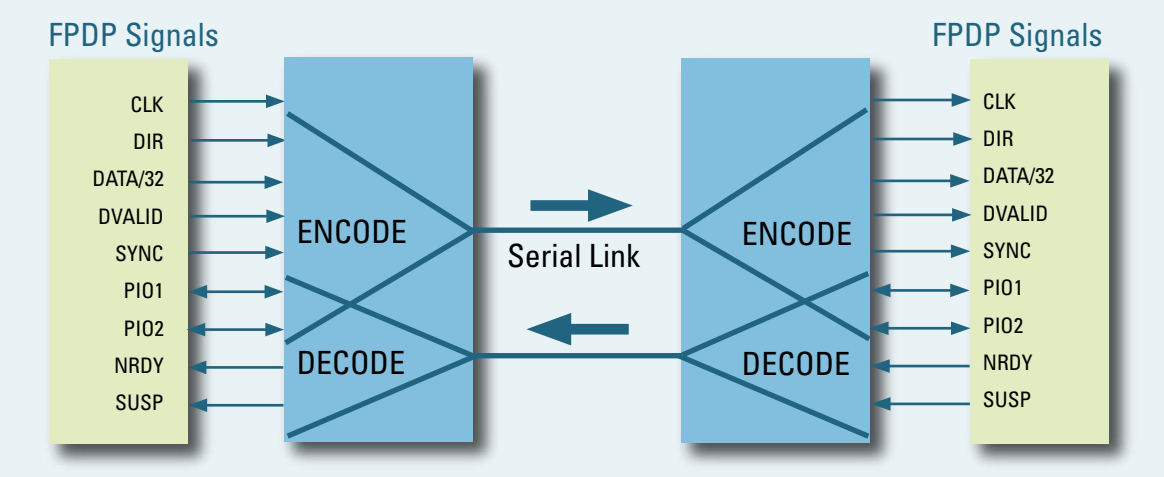


Packing example

Serial FPDP – The long range sensor data interface technology

Serial FPDP (ANSI/VITA 17.1) is a technology that is rapidly emerging as an industry standard architecture in today's advanced DSP systems. The parallel FPDP has one limitation – the equipment must be located only a few meters apart at most. This becomes a

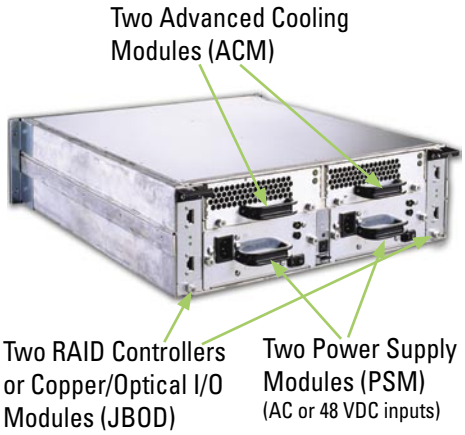
challenge if for example the sensors are located far away from the processors. Serial FPDP was developed to overcome this distance limitation. Serial FPDP simply serializes the FPDP data stream and transmits it over extended distances (up to 10 Km).



Serial FPDP concept

At the low level, Serial FPDP uses the same technology as Fibre Channel for the protocol primitives, basic encoding, physical trancievers and media. Serial FPDP can use either copper or SWL/LWL fiber optical media just like Fibre Channel, and it can run in either 1 or 2.4 Gbit/sec bit rate giving a possible sustained data rate at up to 250 Mbytes/sec. Serial FPDP is a flexible and efficient protocol that is easily adapted to a variety of real-time data collection and processing systems. It is currently being used in a wide range of applications such as radar, sonar and imaging systems.

Serial FPDP PMC



VMETRO's JBOD can be fitted with internal RAID controller(s) and has redundant fan and PSU

STORAGE SYSTEM

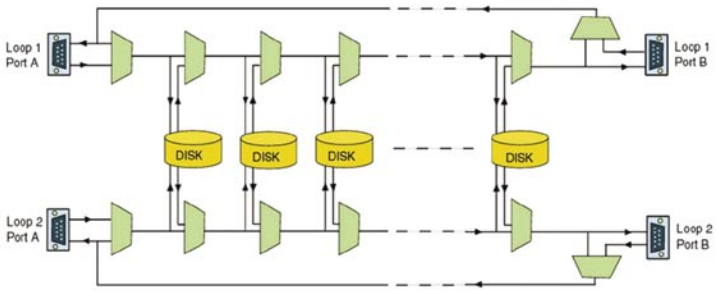
Fibre Channel RAID or JBOD Disk Storage

MDR relies on arrays of state-of-the-art commercial disk drives as the permanent storage medium. The typical storage system of an MDR has a storage capacity that ranges from tens of Gigabytes up to Terabytes, with disks configured as cost-effective JBOD (Just a Bunch Of Disks) units or as complete integrated RAID (Redundant Array of Independent Disks) units with built-in redundancy to survive a single disk drive failure.

VMETRO's Fibre Channel Disk Array (JBOD)

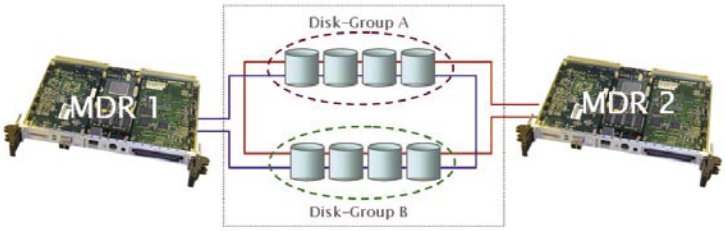
The disk units are connected to MDR with Fibre Channel Arbitrated Loop (FC-AL) using the SCSI-FCP protocol and command set to communicate with the disk system. Up to 125 disks units may be connected to the same physical loop. MDR supports Fibre Channel both with fiber optic or differential twinax copper cables (depending on MDR model, see order information), Hubs and switches can be incorporated in the storage system to enable convenient cabling, easy reconfiguration, maximum flexibility and scalability.

The VMETRO JBOD supports dual Fibre Channel loops so that all the disks can be accessed from two separate channels. In addition each of the two loops can be split in two so that half of the disks can be accessed on one or two separate loops. This way, it is possible to gain full speed access to different sets of disks at the same time without the necessity of introducing a Fibre Channel switch or additional disk cabinets.



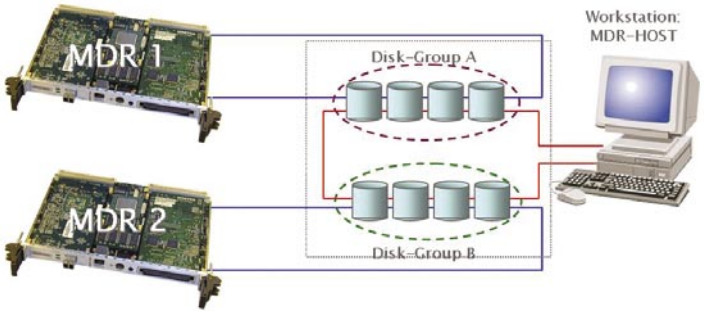
Dual loop JBOD configuration

In a typical MDR application, one may want to record to one set of disks, and perform playback from another set of disks without having to suffer the performance degradation that will occur using a single Fibre Channel loop for all traffic.



Dual loop JBOD usage: The two MDRs can perform full speed recording or playback to separate disk groups concurrently.

Similarly, in a dual MDR application, double recording speed can be attained on a single JBOD by letting the MDRs record to each half of the disk array of the split loop. The other loop in the JBOD can be connected to the host that can access all disks directly.



Split loop JBOD usage: As above the two MDRs can perform full speed recording or playback to separate disk groups in the same JBOD at full speed concurrently. In addition the MDR-Host is connected so that it can access both disk groups.

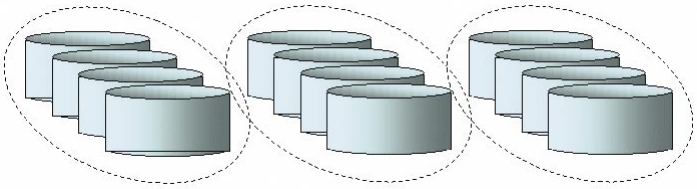
MDR Features

Ready-to-Run Software

MDR systems are delivered as pre-programmed units with software in FLASH memory for data acquisition and storage management.

Higher recording speed by Disk grouping and striping

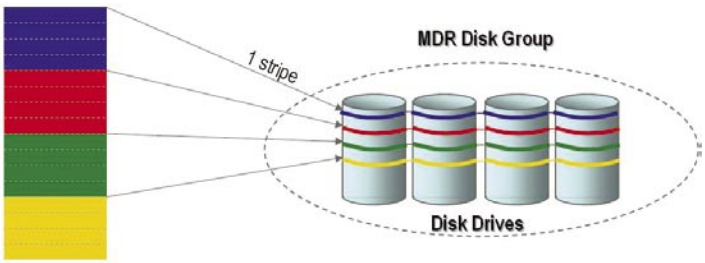
The disks in the Storage Area Network (SAN) connected to the MDR can be organized in Disk Groups. A disk group is considered as a singular storage device for MDR and the disks in a group are subordinated in a RAID-0 "striping" operation. "RAID-x" are different ways to organize several disks into one bigger disk with different operational and redundancy options. "RAID-0" means simply to concatenate several disks into one larger virtual disk. MDR does this for two reasons: To get larger recording capacity, and to attain higher recording speed by using "striping" operation.



Disk grouping concept: The MDR uses RAID-0 disk groups as singular storage devices

Very high recording performance is obtained by striping (interleaving) data across multiple disks. Whereas "RAID-0" means to organize several disks into one larger virtual disk, "striping" does this by alternating blocks between the drives in a round-robin fashion rather than putting the drives after each other. The benefit of this scheme is that it is possible to distribute the data on several drives at once and get a much higher transfer rate to storage than is possible to a single disk.

The disk grouping system is fully plug-and-play as the MDR keeps the disk group information on all the drives such that the group will be automatically reconstructed when moved to another host or MDR regardless of which order the drives are installed.



RAID-0 striping principle, MDR gains speed as load is shared between the drives in a disk group

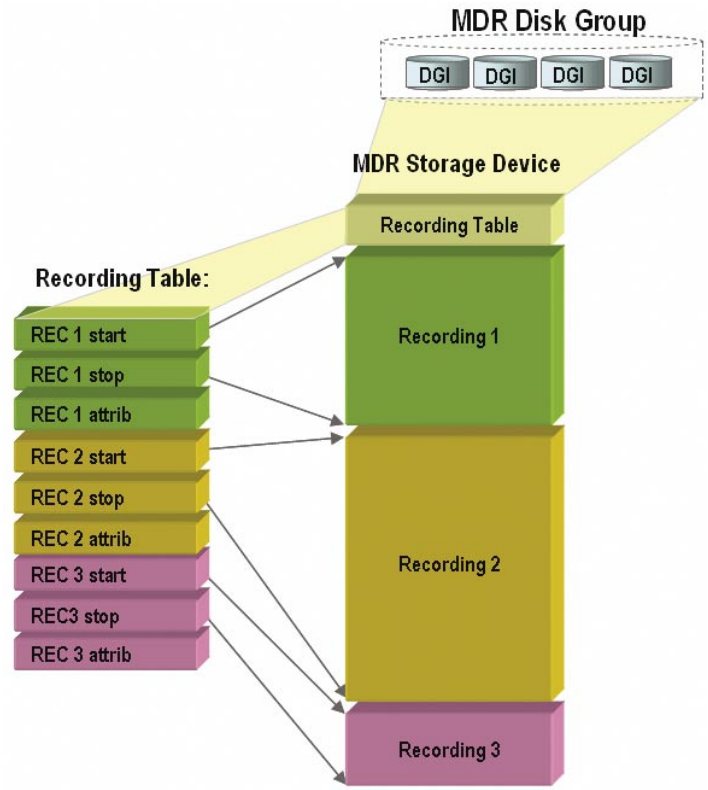
Data Storage Format - Real-Time file system

The MDR storage system is organized as block devices. A block device divides the storage medium into a number of blocks, where

a unique number addresses each block. The storage system is typically much larger than each recording, therefore the MDR implements functionality for storing several recordings. Each recording must be given the following attributes:

- **Name**
- **Block number identifying the start of the recording**
- **Number of blocks specifying the size of the recording, or block number identifying the end of the recording**

The user must specify these parameters before a recording is started. The recording parameters of all recordings are stored in the recording table, which is located in a "system reserved" partition of the storage device(s).



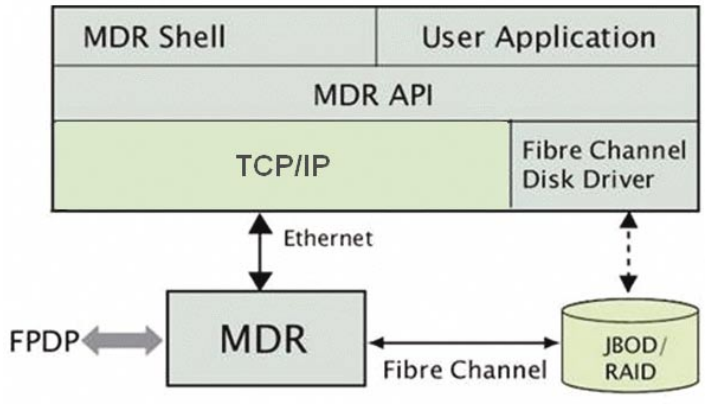
MDR's real-time file system structure ("Recording Table")

Operating from host computer

For operation from a host computer via a network (TCP/IP Ethernet), a separate host software package is offered (MDR-HOST-SW), supporting the following platforms:

- **PC/Windows NT**
- **Windows 2000**
- **SPARC/Solaris**
- **PowerPC/VxWorks (Contact Factory)**

MDR-Host concept



MDR-Host connection

The host software is client-based, and communicates with an MDR server running on an i960 CPU on the MDR board. A driver is also included for VMETRO's VMFC-2x00 family of Fibre Channel adapters for PCI, PMC and CompactPCI™, to be used with the host for fast disk readback and preload (Windows or Solaris only). No user programming is needed unless the user wants to integrate the MDR system into his application using the MDR C++ API.

new-recording	***Create a new recording***
set-start-block	***Set startblock of current recording***
record	***Start record operation***
playback	***Start playback operation***
stop	***Stop ongoing record/playback operation***
dump-recording	***Dump (display) recording data to screen***
copy-recording	***Copy data recording between host and SAN***
delete-recording	***Delete a recording***
show-recording-table	***Show the recording table***
format-disk	***Format one disk or a disk group***

MDR-Shell command set

TCP/IP via Ethernet. It is also possible to control multiple MDRs from the same host. This is particularly useful for building multi-channel recorders.

Integration of MDR system into a specific application

The MDR API is a C++ Application Programming Interface that allows the user to integrate the MDR system into his application. The MDR API offers essentially the same functions as described above for the MDR shell.

Data Readback to the Host

MDR provides several ways to read recorded data back from the disk storage system to a host system (or vice versa for preload in a playback application).

Copy to File on Host via network

Recorded data (or part of it) may be copied to one or several files on the host via the MDR network connection (Ethernet). The read-back rate via Ethernet is approximately 1 MB/s.

Faster read-back to host via Fibre Channel

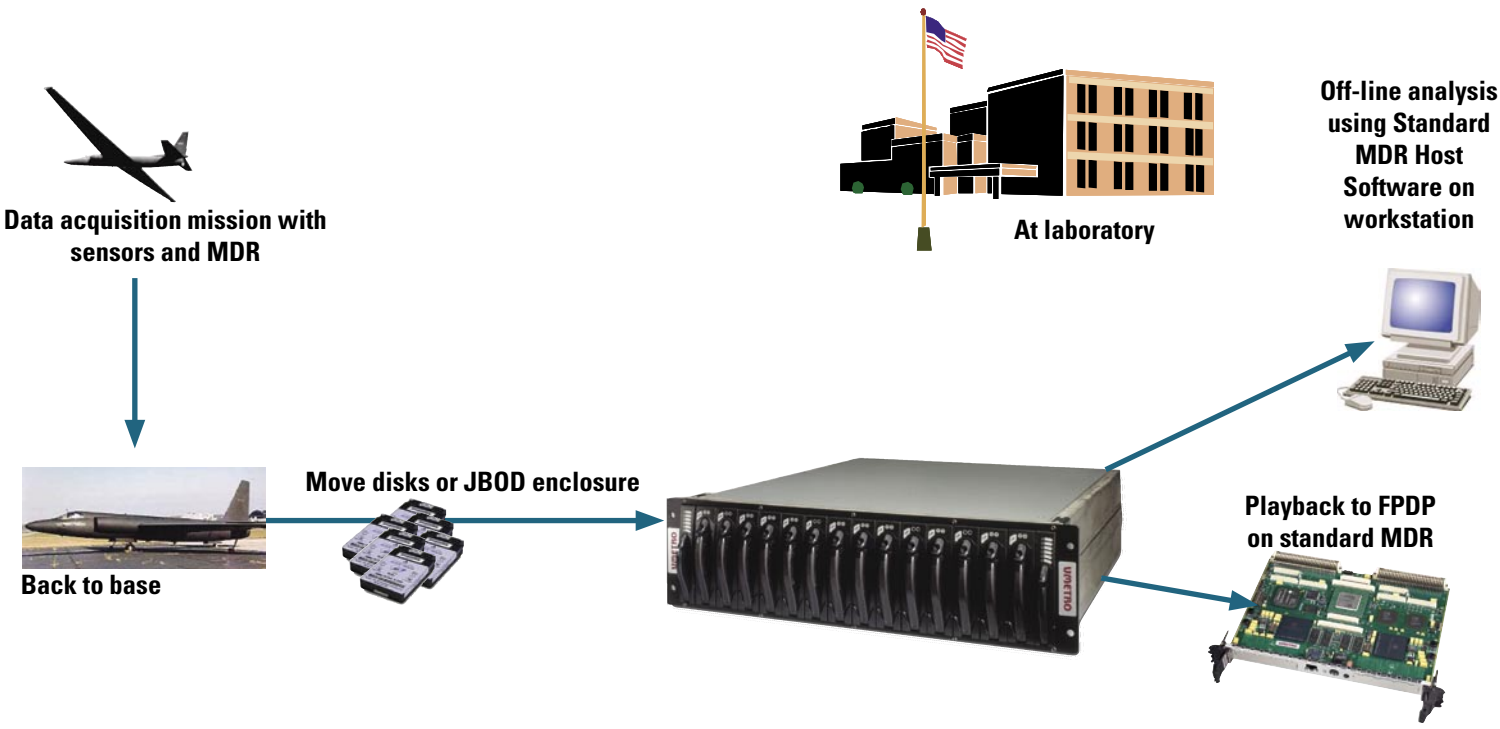
For the fastest possible readback of the data from the disk storage system, the RAID or JBOD disk storage system may be attached directly to the host. This requires that the host is equipped with a Fibre Channel adapter (VMFC-2xxx), and normally gives a read-back speed of 40-80 MB/s, depending on the host system. In this case, the MDR board itself does not need to be present.

Disk Array Physically Moved to a Different Host

The RAID or JBOD disk storage system may also be attached to a different host (equipped with a VMFC-2xxx Fibre Channel adapter) than the one used during recording, i.e. the host and disk storage system are totally de-coupled from the MDR board itself. This can, for example, be used to physically move the disk array to a lab after the recording is done in a deployed system in the field. In a playback application, this can, for example, be used to preload data on the disk array before it is physically moved to the site where real-time playback will take place through the MDR board. The disk group(s) contained on the drives, are automatically reconstructed regardless of in which order they are installed in MDR or MDR-Host, the disk grouping system is fully plug and play.

Reading recorded data to Host Memory using the API

The MDR API provides a function for reading parts of a recording to a user memory buffer on the host system. This allows for post-processing of the recorded data by the host without first having to store data to a file.



Example of a data-acquisition application where the disk drives are moved from the on-board recording system to an MDR Host or a playback MDR in the lab.

MDR Order Information

Entry level FPDP Recorder, 80-95 Mbytes/sec:

MDR-320PT-DC FPDP Data Recorder, 1Gbit/sec FC, Dual Copper

FPDP / FPDP II Recorder, 140-160 Mbytes/sec:

MDR-420PT-SF FPDP/FPDP II Data Recorder, 2Gbit/sec FC, Single Fiber

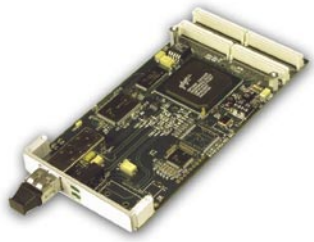
MDR-422PT-SF FPDP/FPDP II Data Recorder w/playback, 2Gbit/sec FC, Single Fiber

Serial FPDP Recorder, 140-160 Mbytes/sec:

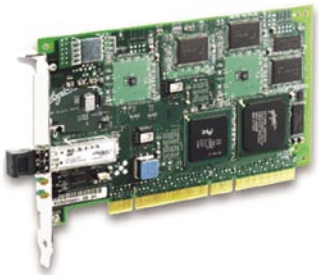
MDR-422S2-SF Serial FPDP Data Recorder w/playback, 2Gbit/sec FC, Single Fiber

Accessories for Host Computer / Workstation Connectivity

MDR-HOST-SW MDR Host Software. Includes MDR Shell and API, drivers for VMFC-2xxx family of Fibre Channel adapters for PCI, PMC and CompactPCI™. Supports PC/Windows NT 4.0, Windows 2000, SPARC/Solaris.



VMFC-2300-F Fibre Channel Adapter for PMC

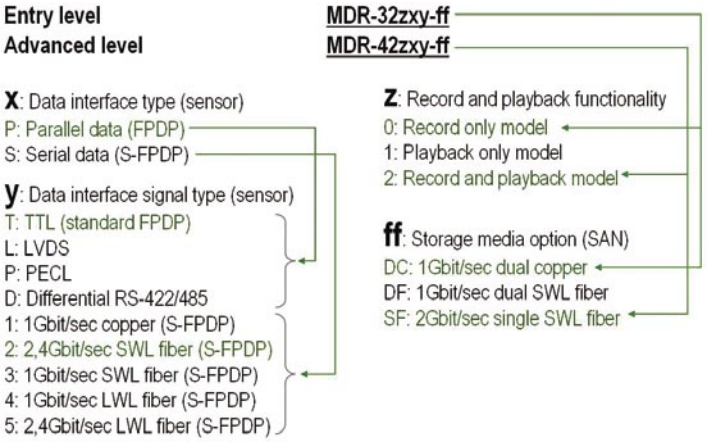


VMFC-2300P-SF Fibre Channel adapter for PCI

Accessories for Host Computer / Workstation Connectivity

MDR can be delivered with other interfaces such as LVDS, PECL and RS-422/485 and with other media options on the Fibre Channel SAN interface. See below for model numbering. Please consult factory ordering any models than the above standard ones for availability and delivery information.

MDR Model Numbering:



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